WHAT IS CLAIMED IS:

1. A method for thermally cycling samples of biological material in an apparatus with at least one sample holder located in a thermal block assembly, comprising the steps of:

inserting at least one sample of biological material into a sample holder of the apparatus;

measuring the temperature of the thermal block assembly at at least one location on the thermal block assembly;

calculating the desired temperature of the thermal block assembly;

comparing the desired temperature with the measured temperature, and if the measured temperature is less than the desired temperature, the method further comprises the steps of:

applying a first heat source, a portion of said heat from said first heat source being transferred to the thermal block assembly;

applying a second heat source, a portion of said heat from said second heat source being transferred to the first heater; and

applying a third heat source, a portion of said heat from said third heat source being transferred to the sample holders;

if the measured temperature is greater than the desired temperature, the method further comprises the step of cooling the thermal block assembly by imparting a

cooling convection current on a heat sink which is thermally coupled to the thermal block assembly to provide heat transfer from the thermal block assembly to ambient air in contact with the heat sink; and

repeating the steps of measuring, calculating, and comparing until the predetermined thermal cycle for the samples of biological material is completed.

2. The method of claim 1 wherein the step of applying the second heat source includes applying said second heat source to the heat sink on which the second heat source is located, said heat sink then imparting a portion of the heat from the second heat source to the first heat source.

3. The method of claim 2 wherein the step of measuring the temperature of the thermal block assembly includes measuring the temperature at a plurality of locations on the thermal block assembly, and the step of applying the first heat source includes a plurality of first heat sources.

4. The method of claim 1 wherein the step of cooling the thermal block assembly includes using the first heat source to cool the thermal block assembly.

5. The method of claim 1 wherein the step of inserting at least one sample of biological material into a sample holder includes inserting a sample tube of biological reaction mixture into a sample well of the apparatus.

6. An apparatus for thermally cycling samples of biological material comprising:

a thermal block assembly including a plurality of sample holders for receiving samples of biological material;

a heat sink located below the thermal block assembly and thermally coupled to the thermal block assembly to transfer heat away from the thermal block assembly;

a first heat source located between the thermal block assembly and the heat sink, the first heat source thermally coupled to the thermal block assembly to heat the thermal block assembly; and

a second heat source located below the first heat source with a portion of the second heat source extending beyond the first heat source, the second heat source thermally coupled to the first heat source to heat at least a portion of the first heat source.

7. The apparatus of claim 1 wherein a stacked arrangement of the first heat source, the second heat source and the heat sink provides substantial temperature uniformity among the plurality of sample holders.

8. The apparatus of claim 1 wherein the first heat source includes at least one thermoelectric heater utilizing the Peltier effect for heating the thermal block assembly with substantial temperature uniformity by heating at least a portion adjacent the edges of the thermal block assembly.

9. The apparatus of claim 1 wherein the first heat source is located on an outer surface of the heat sink causing a temperature gradient across the heat sink.

10. The apparatus of claim 1 wherein the second heat source is located adjacent to at least a portion of the heat sink radially outside of a portion on which the first heat source is located.

11. The apparatus of claim 1 wherein a substantial portion of the second heat source is located outside the first heat source.

12. The apparatus of claim 1 wherein the second heat source includes at least one resistive element heater.

13. The apparatus of claim 1 wherein the first heat source has a higher temperature side and a lower temperature side, the higher temperature side having a higher temperature at an outer periphery of the first heat source than at an inner periphery of the first heat source corresponding approximately to a temperature gradient across the heat sink.

14. The apparatus of claim 1 further comprising a first thermal interface element located between the thermal block assembly and the first heat source to transfer heat to the thermal block assembly.

15. The apparatus of claim 1 further comprising a second thermal interface element located between the heat sink and a lower temperature side of the first heat source to transfer heat and extend the cycle life of the first heat source.

16. The apparatus of claim 1 wherein the thermal block assembly further comprises a thermal block plate, the plurality of sample holders engaging the thermal block plate.

17. The apparatus of claim 1 wherein the plurality of sample holders comprise a plurality of sample wells.

18. The apparatus of claim 1 further comprising a spacer bracket wherein the first heat source is positioned in an opening in the spacer bracket.

19. The apparatus of claim 1 further comprising a first insulating cover to thermally insulate the plurality of sample holders of the thermal block assembly.

20. The apparatus of claim 1 further comprising a third heat source including a plate located above the thermal block assembly to heat a plurality of sample tubes respectively located in the plurality of sample holders of the thermal block assembly.

21. The apparatus of claim 1 further comprising a second insulating cover to thermally insulate a plurality of sample tubes respectively located in the plurality of sample holders of the thermal block assembly.

22. The apparatus of claim 21 wherein the insulating second cover comprises a holding assembly for holding the sample tubes in the thermal block assembly by imparting a compressive load to improve the contact surface area between the respective heat sources and the thermal block assembly, and an insulating plate for the thermal block assembly and a first insulating cover.

23. The apparatus of claim 22 wherein the holding assembly of the second insulating cover includes a bracket with a clamping portion located adjacent the second cover for imparting the compressive load on the insulating plate.

24. The apparatus of claim 1 wherein the second heat source is located outside the first heat source.

25. The apparatus of claim 1 wherein the biological material includes a biological reaction mixture.

26. The apparatus of claim 1 wherein the second heat source extends beyond the first heat source toward an edge of the thermal block assembly.

27. The apparatus of claim 1 wherein the apparatus is capable of thermally cycling the samples of biological material with substantial temperature uniformity.

28. An apparatus for thermally cycling samples of biological material with substantial temperature uniformity comprising:

a thermal block assembly including a plurality of sample holders for receiving samples of biological material;

a first heat source located below the thermal block assembly and thermally coupled to the thermal block assembly to heat the thermal block assembly;

a second heat source located below the first heat source with a portion of the second heat source extending beyond the first heat source toward an edge of the thermal block assembly, the second heat source thermally coupled to the first heat source to heat at least a portion of the first heat source; and

a heat sink located below the second heat source and thermally coupled to the thermal block assembly to transfer heat away from the thermal block assembly.

29. The apparatus of claim 28 wherein a stacked arrangement of the first heat source, the second heat source and the heat sink provides substantial temperature uniformity among the plurality of sample holders.

30. The apparatus of claim 28 wherein the first heat source includes at least one thermoelectric heater utilizing the Peltier effect for heating the thermal block assembly with substantial temperature uniformity by heating at least a portion adjacent the edges of the thermal block assembly.

31. The apparatus of claim 28 wherein the first heat source is located on an outer surface of the heat sink causing a temperature gradient across the heat sink.

32. The apparatus of claim 28 wherein the second heat source is located adjacent to at least a portion of the heat sink radially outside of a portion on which the first heat source is located.

33. The apparatus of claim 28 wherein a substantial portion of the second heat source is located outside the first heat source.

34. The apparatus of claim 28 wherein the second heat source includes at least one resistive element heater.

35. The apparatus of claim 28 wherein the first heat source has a higher temperature side and a lower temperature side, the higher temperature side having a higher temperature at an outer periphery of the first heat source than at an inner periphery of the first heat source corresponding approximately to a temperature gradient across the heat sink.

36. The apparatus of claim 28 further comprising a first thermal interface element located between the thermal block assembly and the first heat source to transfer heat to the thermal block assembly.

37. The apparatus of claim 28 further comprising a second thermal interface element located between the heat sink and a lower temperature side of the first heat source to transfer heat and extend the cycle life of the first heat source.

38. The apparatus of claim 28 wherein the thermal block assembly further comprises a thermal block plate, the plurality of sample holders engaging the thermal block plate.

39. The apparatus of claim 28 wherein the plurality of sample holders comprise a plurality of sample wells.

40. The apparatus of claim 28 further comprising a spacer bracket wherein the first heat source is positioned in an opening in the spacer bracket.

41. The apparatus of claim 28 further comprising a first cover of insulating material to thermally insulate the plurality of sample holders of the thermal block assembly.

42. The apparatus of claim 28 further comprising a third heat source including a plate located above the thermal block assembly to heat a plurality of sample tubes respectively located in the plurality of sample holders of the thermal block assembly.

43. The apparatus of claim 28 further comprising a second cover of insulating material to thermally insulate a plurality of sample tubes respectively located in the plurality of sample holders of the thermal block assembly.

44. The apparatus of claim 43 wherein the second cover comprises a holding assembly for holding the sample tubes in the thermal block assembly by imparting a compressive load to

improve the contact surface area between the respective heat sources and the thermal block assembly, and an insulating plate for the thermal block assembly and a first cover.

45. The apparatus of claim 44 wherein the holding assembly of the second cover includes a bracket with a clamping portion located adjacent the second cover for imparting the compressive load on the insulating plate.

46. The apparatus of claim 28 wherein the second heat source is located outside the first heat source.

47. The apparatus of claim 28 wherein the biological material includes a biological reaction mixture.